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Air Quality Change Related to Particulate Matter in Some Selected Green Areas in Sanliurfa

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ABSTRACT

The air, which is of vital importance for human and other living creatures to survive, must have a certain quality. Depending on various reasons, the air quality decreases at different places and times and the air can be polluted. Especially with the industrial revolution, the problem of air pollution started to affect people first locally and then globally. With the industrial revolution and the development of technology, the rapid population growth, intense and unplanned urbanization, the great increase in the number of motor vehicles and the developments and changes in land use made people's lives easier, and they also faced serious enviromental problems.. Parks and green areas that allow breathing in the city can prevent these problems to some extent. In our study, the city of Şanlıurfa, which has desert areas and alluvial fields in its close vicinity and reached peak values in certain periods in terms of the amount of particulate matter, was used. Green areas and parks with different characteristics have been preferred in the central districts (Haliliye-Eyyübiye-Karaköprü). Particulate matter measurements were carried out at 09:00 in the morning and 15:00 in the afternoon in these areas. The measurements were made with CEM DT-9880 device in 6 dimensions. As a result of the measurements the highest amount of particulate matter was experienced in the Ottoman promenade area of Eyyübiye district at 09.00 and 15.00. It has been determined that the lowest amount of particulate matter is in the Karaköprü recreation area in Karaköprü district. In addition, it has been found that the amount of particulate matter is high in the parks and green areas along the main road.

Anahtar Kelimeler:
Şehir,
Yeşil Alanlar,
Hava Kalitesi,
Partikül Madde,
Şanlıurfa.

ÖZ

İnsan ve diğer canlıların yaşamlarını sürdürebilmeleri için hayati öneme sahip olan havanın belirli bir kalitede olması gerekmektedir. Çeşitli nedenlere bağlı olarak farklı yer ve zamanlarda hava kalitesi düşmekte ve hava kirlenebilmektedir. Özellikle sanayi devrimiyle birlikte önce lokal anlamda sonrada küresel anlamda hava kirliliği sorunu insanları etkilemeye başlamıştır. Sanayi devriminin gerçekleşmesi ve teknolojinin gelişmesiyle birlikte yaşanan hızlı nüfus artışı, yoğun ve plansız şehirleşme, motorlu taşıt sayısında yaşanan büyük artış ve arazi kullanımlarında meydana gelen gelişmeler ve değişmeler insanların hayatlarını kolaylaştırmasına imkan tanırken, bunlara bağlı olarak ortaya çıkan çevre sorunları da insanların ve doğanın ciddi sorunlarla karşı karşıya kalmasına neden olmuştur. Şehir içinde nefes alınmasını sağlayan parklar ve yeşil alanlar bu sorunlara bir nebze olsun engel olabilmektedir. Çalışmamızda yakın çevresinde çöl alanları ile alüvyon sahalar bulunan ve partikül madde miktarı bakımından belirli dönemlerde zirve değerlere ulaşan Şanlıurfa şehri kullanılmıştır. Şanlıurfa şehrinde merkez ilçelerde (Haliliye-Eyyübiye-Karaköprü) farklı karakteristik özelliklere sahip yeşil alanlar ve parklar tercih edilmiştir. Bu alanlarda sabah 09.00 ile öğleden sonra 15.00'da partikül madde ölçümü gerçekleştirilmiştir. Partikül madde ölçümü CEM DT-9880 cihazı ile 6 boyut olarak yapılmıştır. Yapılan ölçümler sonucunda

09.00 ve 15.00'da yapılan ölçümlerde en yüksek partikül madde miktarının Eyyübiye ilçesi Osmanlı mesire alanında yaşandığı tespit edilmiştir. En düşük partikül madde miktarının da Karaköprü ilçesinde yer alan Karaköprü mesire alanında olduğu tespit edilmiştir. Ayrıca anayol kenarında yer alan parklarda ve yeşil alanlarda da partikül madde miktarının yüksek olduğu tespit edilmiştir.

1. Introduction

Air, which is vital for humans and other living creatures to survive, must have a certain quality. Depending on various reasons, the air quality decreases in different places and times and the air can be polluted. The concept of air pollution emerged with the industrial revolution, as a result of rapid population growth, excessive use of natural resources and urbanization as a problem affecting humanity [1]. Air pollution, especially in cities and industrial areas, has been a serious problem for human health for years [2]. Half of the world's population [3] and 2/3 of the population of European countries live in cities [4-5]. In this respect, the majority of the population living in cities on a global scale is affected by air pollution.

The rapid population growth, industrialization and increases in the number of motor vehicles, especially in cities, have led to a rise in air pollution values [6]. Apart from these, pollutants released into the atmosphere as a result of natural and human resources can adversely affect every environment, especially living things. After the pollutants in the air exceed a certain threshold, they become harmful for living and non-living beings [7]. The pollutants in the air cause people to get sick or even lose their lives. Air pollution is an important environmental health problem affecting all countries. According to estimates, more than 3 million people die each year from air pollution [8] or are negatively affected by this pollution.

Among the most important air pollutants are particulate matter (PM), sulfur dioxide (SO2), carbon monoxide (CO), ozone (O3), azotoxides (NOx) and hydrocarbons (HC) [9]. Particulate matter, present in different sizes as a result of natural and human processes, is also very dangerous among these pollutants. Exposure to particulate matter of various sizes can adversely affect human health, plants, animals and human structures especially. PM10 (coarse particles) and PM2.5 (fine particles) refer to the masses of particles with an aerodynamic diameter less than 10 and 2.5 μm, respectively [10]. Particulate matter settles in different regions of the human lung according to their size. Particulate matter smaller than roughly 2.5 μm can accumulate in the capillaries of the lung, while those with an aerodynamic diameter greater than 10 μm can accumulate in the upper respiratory tract or directly in the lung. Particulate substances in the atmosphere can also cause various diseases. Some of these diseases are COPD, lung cancer, asthma, cough, upper respiratory tract infection, bronchitis, etc.

Sources of particulate matter in the atmosphere are divided into two as natural and human. Some of the natural resource examples are soil, desert, sea and volcanic activities; human resources are fossil fuels, industrial facilities, agricultural activities, transportation activities, etc. The biggest factor in the formation of air pollution is human activities. The effects of air pollution resulting from human activities may vary regionally [11]. Cities are at the forefront of places where the impact of human activities is intense. Areas with industrial, residential and central business areas in the city are generally highly sensitive areas in terms of air pollution. In case the necessary precautions are not taken, a significant degree of air pollution occurs in industrial production processes, heating of houses and daily activities in the central business area. There are also some areas that absorb this pollution in the city. The most important of these areas are wooded and green areas. Generally, in the green areas in the city, the most intensive areas where plants are used are roadsides and parks. The green areas seen and used in cities today have emerged as a solution to environmental problems caused by industry [12]. These areas are used in different ways by many people with the thought of high air cleaning effect [13]. The green areas where human activities are intensely seen, housing gardens, children's playgrounds, neighborhood and district parks, cemeteries, botanical gardens, exhibition and fair areas, food production areas, such areas are resting, sitting, picnicking, running, and walking In addition to recreational and sportive activities such as making, products, plants and tree cultivation, and many other activities such as education [14]. These areas make a great contribution to the reduction of air pollution in the city and the protection of human health [15] and are also extremely important and effective in reducing carbon dioxide and other pollutants [16]. However, the green areas in the city are gradually decreasing as a result of the rapid increase in population and construction [17-18]. The level of air pollution is low in cities with large forest areas and large amounts of green areas [19]. However, in general, little importance is given to green areas in urban areas and in planning, they have very little competencies to meet the needs of cities [20].

In this study, it was aimed to determine the air quality in terms of particulate matter pollution in some green areas in Sanliurfa city. For this purpose, particulate matter measurements in 6 different sizes were carried out at certain times during the day. The results were evaluated and interpreted with their causes and results.

2. Material and Method

To determine measurement locations, the size of the area and the district difference were taken into account. In addition to these, the proximity to the main roads was also taken into account. Measurements were made in 9 green areas which are 4 in Haliliye, 3 in Karaköprü and 2 in Eyyübiye (Table 1 and Figure 1). Measurements at the locations in Table 1 were made in December 2020, 2021, January and February. Periodic measurements were performed for 3 months, 2 days on weekdays and 2 days on weekends in December, January and February. The altitude of the locations varies between 500 and 680 m. In addition, particulate matter measurements were carried out at different points of the measurement areas. Measurements were carried out with the CEM DT-9880 6-channel particulate matter meter. The device gives measurement values in dimensions of 0.3, 0.5, 1.0, 2.5, 5.0 and 10 µg / m³. The particulate matter meter shows the particulate matter amount in µg / m³ by passing the air flow through it for 21 seconds. The measurements were carried out at 09.00 and 15.00. The values obtained were averaged and processed in graphics and tables. The processed values were analyzed and interpreted.

Table 1. General Characteristics of the Study Area

Location	District	Attribute Status	Tree Presence	Area (m^2)	Altitude	Latitude	Longitude
Cumhuriyet Park (CP)	Haliliye	Promenade Area/Park	Low	120.000	500	37° 9' 51''	38° 50' 41''
Çamlık Park (ÇP)	Haliliye	Park	High	21.494	580	37° 10' 28''	38° 48' 18''
Fatih Sultan Mehmet Park (FSMP)	Haliliye	Park	High	66.140	581	37° 10' 39''	38° 48' 16''
Selahaddin Eyyübi Park (SEP)	Haliliye	Park	Low	80.000	583	37° 10' 43''	38° 46' 45''
Karaköprü Mesire Alanı (KMA)	Karaköprü	Alanı	High	115.000	624	37° 13' 48''	38° 48' 01''
Çocuk Oyun Dünyası (ÇOD)	Karaköprü	Play Ground	Low	30.000	654	37° 11' 53''	38° 48' 55''
İbrahim Tatlıses Park (İTP)	Karaköprü	Park	Low	14.423	595	37° 12' 45''	38° 47' 52''
Halepli Bahçe (HB)	Eyyübiye	Park	Low	120.000	530	37° 9' 11''	38° 46' 58''
Osmanlı Mesire Alanı (OMA)	Eyyübiye	Promenade Area	High	220.000	526	37° 6' 59''	38° 47' 42''

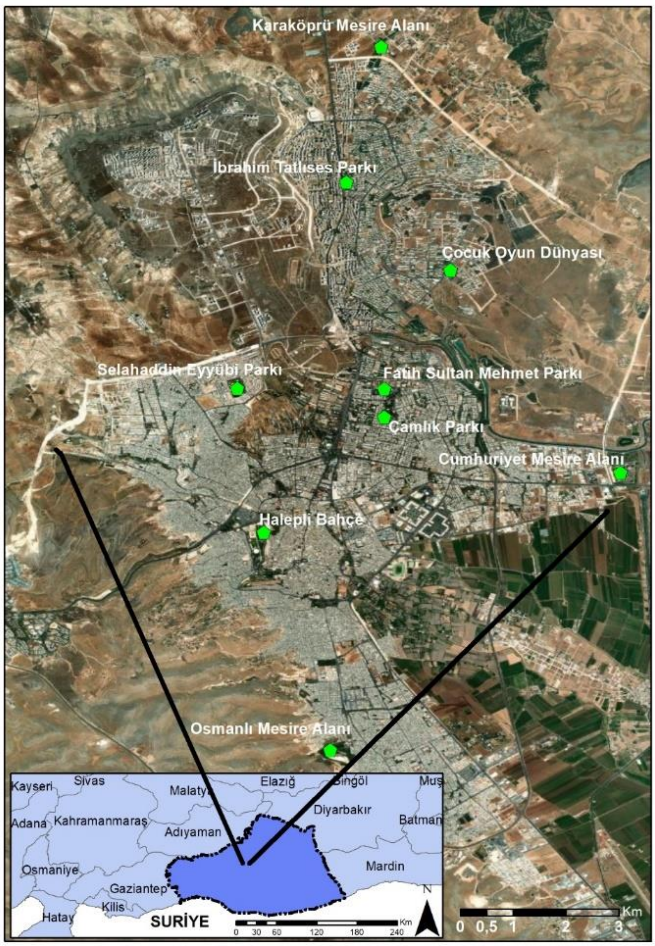

Figure 1. Sanliurfa City Measurement Points

3. Results

When the measurements of the particulate matter and meteorological data taken in the morning and afternoon in some selected green areas in the city of Sanliurfa were evaluated, it was seen that the amount of particulate matter in six dimensions in the Ottoman promenade area was quite high in both measurements compared to other areas. (Table 2, Figure 2).

When it is listed according to the lowest in the size of 0.3 µm in morning measurement, OMA> CP> HB> ITP> SEP> ÇOD> FSMP> KMA. While the highest value is OMA 82256, this value decreases to 8998 in KMA. In the afternoon measurement, it was observed that OMA> CP> HB> ITP> SEP> ÇP> ÇOD> FSMP> KMA, respectively. Although the pollution level remained almost the same, only ITP, ÇP and SEP were replaced. Particulate matter pollution with a size of 0.3 µm decreased in ITP and SEP, while it increased in FP.

When the particulate matter values of 0.5 µm in the measurement areas are examined, it is seen that the pollution order is OMA> CP> ÇP> HB> SEP> ITP> FSMP> ÇOD> KMA. Particulate matter was measured in the highest OMA 20453 and in the lowest KMA (Table 2, Figure 2). In the afternoon measurement, the pollution values were reached with the order of OMA> HB> CP> ÇOD> SEP> ITP> FMSP> ÇP> KMA. In the second measurement, the highest particulate matter values were reached in OMA with 28123, and the lowest in KMA with 3201. The stations that change places in the measurements taken in the morning and in the afternoon are CP, HB, ÇOD and ÇP. According to the morning

measurement, while the pollution decreased in CP and FP, the pollution level in ÇOD and HB increased (Table 3, Figure 3).

Table 2. Measurement Point Values (Morning-09.00)

Ölçüm Yeri	0.3 µm	0.5 µm	1.0 µm	2.5 µm	5.0 µm	10 µm
OMA	82256	20453	3386	720	119	42
CP	24001	6461	1306	281	46	12
ÇP	17789	5135	1051	275	57	20
FSMP	12633	3490	769	122	26	16
HB	19730	4688	881	159	25	6
İTP	14408	3895	765	210	66	24
KMA	8998	2344	560	126	6	1
SEP	14374	3927	763	122	16	5
ÇOD	12801	3493	720	213	24	9

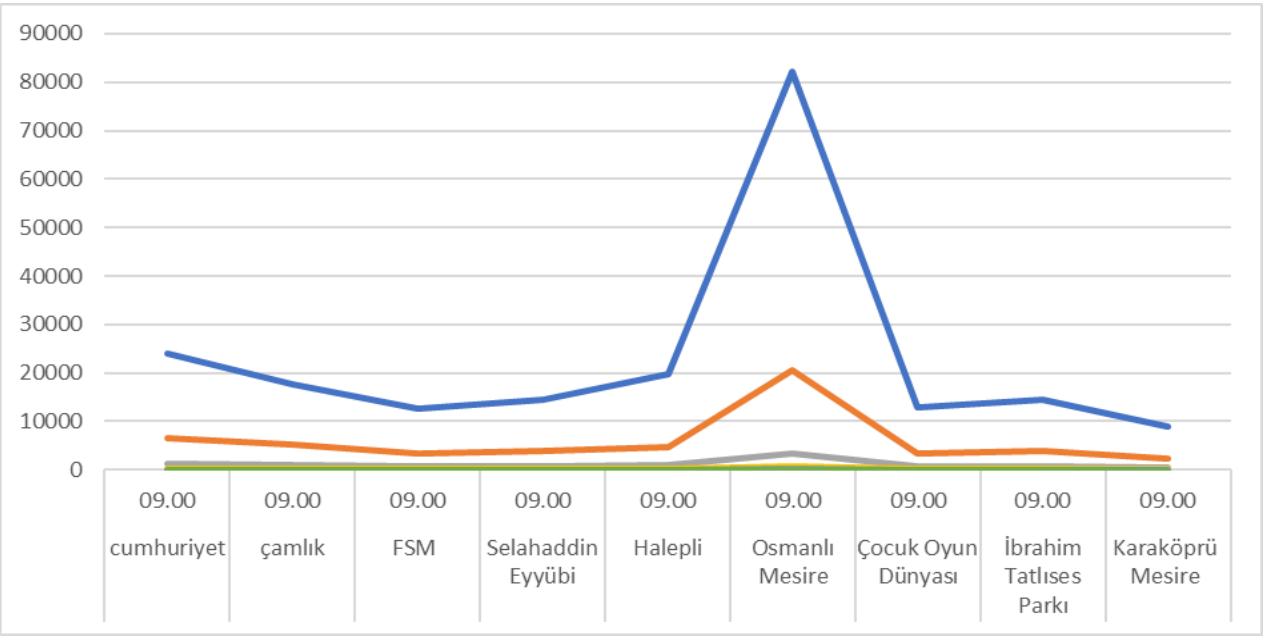

Figure 2. Change of Measurement Points in Morning Time

When the particulate matter values of 1 µm in the measurement areas are examined, it is seen that there is a pollution order of OMA> CP> ÇP> HB> FSMP> ITP> SEP> ÇOD> KMA in the morning measurement. Particulate matter was measured as 3386 in the highest OMA and 560 in the lowest KMA (Table 2, Figure 2). In the afternoon measurements, the pollution order OMA> CP> HB> SEP> ÇP> ÇOD> ITP> FSMP> KMA was formed. Stations varying between morning measurement and afternoon measurements, and all stations except OMA, CP and KMA show a change in pollution level. While the pollution level increased at HB, SEP and ÇOD stations according to the morning measurement, the pollution level decreased relatively at the FP and FSMP stations (Table 3, Figure 3).

Table 3. Measurement Point Values (Afternoon-15.00)

Ölçüm Yeri	0.3 µm	0.5 µm	1.0 µm	2.5 µm	5.0 µm	10 µm
OMA	97632	28123	4500	1250	154	67
CP	25785	4896	1459	156	54	24
ÇP	15789	3569	957	178	40	17
FSMP	12123	3596	787	136	28	16
HB	20159	5698	1236	221	45	36
İTP	16365	4236	830	302	86	35
KMA	9658	3201	657	165	10	5
SEP	15986	4502	1023	159	32	15
ÇOD	13695	4698	854	318	39	15

Looking at the 2.5 µm size particulate matter values of the measurement areas, it is seen that the pollution is listed as OMA> CP> ÇP> ÇOD> ITP> HB> KMA> FSMP = SEP in the morning measurement. The highest value was measured as 720 in OMA and the lowest as 122 in SEP and FSMP (Table 2, Figure 2). In the afternoon measurements, the pollution order was created as OMA> ÇOD> ITP> HB> ÇP> KMA> SEP> CP> FSMP. The highest value was measured as 1250 in OMA and the lowest as 136 in FSMP. The pollution change took place at all stations except the OMA station. According to the morning measurement, while the pollution due to particulate matter increased in the ÇOD, ITP, HB, KMA and SEP, the pollution values decreased at the FP and CP stations. FSMP remained in the same order (Table 3, Figure 3).

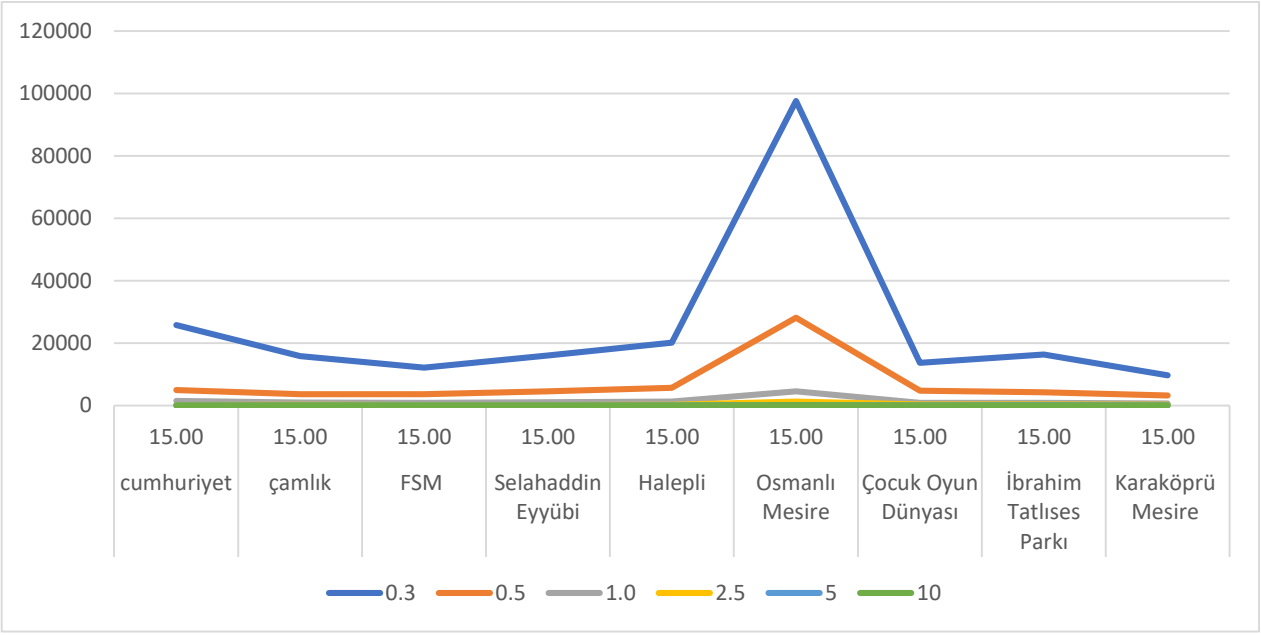

Figure 3. Change of Measurement Points in the Afternoon

When looking at the 5 µm size particulate matter values of the measurement areas, the order is OMA> ITP> ÇP> CP> HB> FSMP> CHOD> SEP> KMA. In the morning measurement, the highest value was measured as 119 in OMA, while the lowest value was measured as 9 in KMA (Table 2, Figure 2). In the afternoon measurement, the order has changed as OMA> ITP> CP> HB> ÇP> ÇOD> SEP> FSMP> KMA. It was measured as 154 in the highest OMA and 10 in the KMA. The pollution change took place at stations CP, HB, ÇP, ÇOD, SEP and FSMP. While the pollution level increased in CP, HB, ÇOD and SEP, it decreased in FP and FSMP (Table 3, Figure 3).

Finally, looking at the particulate matter values of 10 µm in the measurement areas, the pollution order in the morning measurement is OMA> ITP> ÇP> FSMP> CP> ÇOD> HB> SEP> KMA. It was measured as 42 in the highest OMA and

1 in the KMA (Table 2, Figure 2). In the afternoon measurement, the pollution order was formed as OMA> HB> ITP> CP> ÇP> FSMP> SEP = ÇOD> KMA. It was measured as 67 in the highest OMA and 5 in the KMA. When looking at the change of pollution, it is seen that it changes in ITP, ÇP, CP, FSMP, ÇOD, SEP and HB. Comparing the measurements in the morning and in the afternoon, while the pollution increased in HB and CP, the pollution level decreased in ITP, FP, FSMP, SEP and ÇOD (Table 3, Figure 3).

4. Discussion and Conclusion

The selection of measurement points from different areas has been an important factor in determining the source of particulate matter contamination. In this respect, it is of great importance that the measurement points are located on the main road, close to the Harran plain, which is an important alluvial deposit for Şanlıurfa, and selected from areas where human circulation is intense, and the source of particulate matter pollution in these areas has been tried to be determined.

As a result of the measurements made in the field, maximum pollution was detected in the morning and afternoon measurements of all sizes, especially in the OMA located in the south of the city. Minimum pollution in six dimensions was detected in the morning and afternoon at KMA. The high number of people in OMA located in Eyyübiye district indicates that more people are affected by particulate matter compared to other districts, and the lower population in KMA indicates that less people are affected by particulate matter. In addition to these, the fact that Eyyübiye is close to the Harran plain causes the pollution to remain longer because it is morphologically surrounded by high areas, while the relatively high areas of Haliliye and Karaköprü affect the duration of the pollution. In general, the pollution level is expected to decrease under normal conditions as we move from south to north in the study area. However, it has been observed that the pollution level is high in the green areas on the main road route.

Exposure to particulate matter for a long time can cause serious lung diseases (asthma, chronic bronchitis, lung cancer, etc.), respiratory tract infections, and even premature deaths. Dust particles coming from the deserts in the near and far surroundings of Şanlıurfa province cause significant particulate matter pollution, especially in the spring and autumn seasons. Especially in these seasons, it is of great importance for people living in the settlements around the Harran plain to wear masks in protection from particulate matter pollution. In addition, on days when particulate matter pollution is intense, local governments should be periodically reminded that people should not go out except to meet their basic needs and do not open doors and windows of their houses.

Competing Interest / Conflict of Interest
The authors declare that they no conflict of interest. None of the authors have any competing interests in the manuscript.

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